Summary

In this study, the researchers Anh Tuan Truong, Casper Corfitz Christensen, and Tommy Pham, were inspired by prior research in the space of HCI in healthcare, and patients' understanding of health information. "Consultation Companion: How a mobile application can help patients understand medical information from their medical consultations" was written from this background.

In Denmark, a significant proportion (10 to 20%) of the overall population encounter challenges related to crucial health literacy aspects, such as comprehending information to make informed decisions and actively participating in healthcare interactions with healthcare workers. Studies emphasise the value of digital instruments, summaries, and virtual agents in improving doctor-patient communication, understanding of medical information, and trust in treatment recommendations. Recording medical consultations has been studied since the late 1970s. It benefits patients in recalling and understanding medical information and can be useful for patients who are overwhelmed with information. However, there are concerns about disruptions and open discussions with healthcare professionals.

We present a qualitative study on participants' usage of a medical records app that aims to enable them to gain a better understanding of their chronic condition and what it entails. Through an analysis of the study, we will answer the following research question: "How can a medical health records application help patients understand the information given to them during a consultation?"

First, to understand chronically ill patients' communication issues with their medical specialists, we conducted a contextualisation study comprising nine interviews to examine how chronically ill patients communicate with their medical specialists. From the contextualisation study, we identified three communication barriers and decided to combat two of them due to the last being too reliant on how medical professionals submit their patients' entries for their health journals.

Second, we developed Consultation Companion, a prototype to act as an artefact to spark conversations during the evaluation to investigate how to overcome the communication barriers identified in the contextualisation study. With permission, the prototype uses data from a real rheumatoid arthritis patient's follow-up consultation with a nurse. We evaluated 13 newly diagnosed patients with rheumatoid arthritis. We analysed the data using inductive thematic analysis and learned how to present medical information to elderly patients, their preferences for mobile applications over physical material, how they would use the system, and the barriers for the adoption of the system.

Third, we discuss the results and reflect on prior studies. The study implies that a medical health records application, such as Consultation Companion, can help patients recall and understand medical information from consultations, reducing the need for a companion. Audio playback and transcription enable patients to review consultations. The system will initially limit the shown information to prevent information overload but allow access to more in-depth information. Furthermore, patients also want to access information from the provided physical pamphlet on the system. Lastly, sharing a consultation's content with family and friends can improve communication and understanding regarding the medical condition.

Lastly, in our future work, we welcome researchers to replicate our study. We recommend looking into the accuracy of audio transcriptions, as it could cause severe consequences with misinterpretations and misinformation. Further research should focus on confirming critical medical information with doctors and patients, as well as assessing transcription accuracy. We believe exploring chronic care management cycles and conducting longitudinal studies would provide valuable insights. Additionally, accessibility features, like text-to-speech and non-physical interactions should be considered for users with physical impairments.

Consultation Companion

How a mobile application can help patients understand medical information from their

medical consultations

Anh Tuan Truong Aalborg University Aalborg, Denmark atruon 16@student.aau.dk Casper Corfitz Christensen Aalborg University Aalborg, Denmark ccch16@student.aau.dk Tommy Pham Aalborg University Aalborg, Denmark tpham18@student.aau.dk

Abstract

Newly diagnosed patients with chronic illnesses are often overwhelmed with information during consultations with their medical specialists. To address this, we look at how a medical health records application can assist patients in understanding the information provided to them during a consultation. First, we conducted a contextualisation study which identified three communication barriers but chose to combat the following two: (1) Information is not communicated in a manner that can be understood by patients, and (2) patients are not prepared for consultations due to a lack of health literacy regarding their diagnosis. Based on these barriers, we developed a prototype for a mobile health record application called 'Consultation Companion'. Evaluations were conducted with 13 rheumatoid arthritis patients providing valuable insights into their experiences with the prototype and their preferences for reviewing medical information. The results highlight how 'Consultation Companion' could reduce the reliance on external companions, the importance of implementing audio playback and transcription features, providing comprehensive information but keeping it hidden until needed and enabling the ability to share health information with friends and family. We also highlight areas and potential barriers to adoption for further research. The study suggests ways to combat the aforementioned communication barriers by introducing a medical health records application that aims to enable patients to better understand medical information, thus establishing more effective communication with medical professionals.

$\label{eq:CCS} Concepts: \bullet \mbox{Human-centered computing} \rightarrow \mbox{Human computer interaction (HCI) systems; } \bullet \mbox{Empirical studies in HCI;}$

Keywords: health literacy, medical specialists, hi-fi prototyping, chronic condition, chronic illness, rheumatoid arthritis

ACM Reference Format:

Anh Tuan Truong, Casper Corfitz Christensen, and Tommy Pham. 2023. Consultation Companion: How a mobile application can help patients understand medical information from their medical

Aalborg University, June 16, 2023, Denmark 2023. ACM ISBN 978-1-4503-XXXX-X/18/06...\$15.00 https://doi.org/XXXXXXXXXXXX consultations. In *Proceedings of ACM Conference (Aalborg University)*. ACM, Aalborg, Denmark, 16 pages. https://doi.org/XXXXXXX.XXXXXXXXX

1 Introduction

General practitioners (GP) are the gateway for the population's inquiries about their health and well-being as they serve as the first point of contact for patients with medical concerns in the Danish health sector. It is the GPs job to assess the patient's need for primary treatment of lesser conditions or potentially refer them to a medical specialist (MS).

In 2021, 12.912.938 doctor visitations with GPs and therapists in the primary national health service were registered by citizens between the age of 60-79 in Denmark. That is approximately an increase of 5% since 2017 (12.254.845) [23]. This statistical representation has been affected by COVID-19, meaning there have been far more consultations with GPs, especially e-consultation (which includes test results on COVID-19 tests).

In Denmark, a significant proportion (10 to 20%) of the overall population encounter challenges related to crucial health literacy aspects, such as comprehending information to make informed decisions and actively participating in healthcare interactions with healthcare workers [5]. To combat that, practitioners and patient associations in Denmark generally recommend bringing companions to consultations or recording the consultations in order to help make sense of the information given [10, 20]. It is believed that consensual recordings benefits both the patients and doctors significantly [22]. Doctors are encouraged to do so by the British Medical Association (BMA), especially if patients may have difficulty remembering information. The BMA found that using recordings in healthcare may benefit patients by enabling them to recall important advice, giving them more time to process information, providing copies of consultations, helping patients and their family members with cognitive impairments, involving family members in care decisions, and aiding in the retention of complex information [2].

To understand chronically ill patients' communication issues with their MSs, we conducted a contextualisation study comprising nine interviews to explore how patients with chronic illnesses communicate with their MSs and how they comprehend their diagnosis. Specifically, we aimed to investigate the communication barriers chronically ill patients experience when communicating with their medical professionals, how the communication affects their understanding of their diagnosis, and understand their motives for information seeking. Using our new understanding of patients' communication barriers, we further investigated how a system can help patients better understand the information given by their doctor during a consultation. We established a collaboration with the Department of Rheumatology of the Regional Hospital in Hjørring in North Jutland, Denmark. The regional hospital allowed us to interview their patients to get insights into their perspectives on what information they need in order to learn more information regarding their chronic condition: Rheumatoid arthritis (RA). The key contributions of this study are:

- (1) An empirical contextualisation study with nine patients. Nine chronically ill patients were interviewed and three communication barriers between the patient and their MS were identified.
- (2) Consultation Companion. A prototype of 'Consultation Companion' is designed to assist patients in better understanding the contents of their recorded consultations.
- (3) An empirical study with 13 patients with RA. From the qualitative analysis of data from 13 patients, we present an understanding of how to help patients understand the information given to them during a consultation.
- (4) Implications and opportunities to help patients recall and understand medical information. Reflecting on our observations and the feedback received from participants, we identified potential implications and opportunities for creating a medical records application that focuses on gaining an understanding of the topics discussed during the consultation, as well as general information seeking.

We present a qualitative study on participants' experience of a medical records app that aims to help them understand their chronic condition better. Through an analysis of the study (N = 13), we will answer the following research question:

RQ. "How can a medical health records application help patients understand the information given to them during a consultation?"

2 Related Work

This chapter looks at the challenges and opportunities of designing mobile applications for healthcare purposes, with a specific emphasis on ensuring usability and accessibility for all users, regardless of their abilities or disabilities. We will also examine papers in HCI regarding doctor-patient communication and how HCI could improve it as well as look into how patients would use such systems. Lastly, we examine research on the potential benefits of using audio recordings of medical consultations as a tool to support patients' understanding and retention of health information.

2.1 Designing for Mobile Applications in Healthcare

A paper by Nunes et al. [18] reviewed 29 HCI studies pertaining to self-care technology, in regard to chronic conditions, to gain an understanding of how patients and carers use and experience the technology. Treating a chronic condition differs from an acute condition, as it is a collaborative endeavour and patients are expected to be actively engaged in their longterm treatments. As patients get more experience with the condition, they start taking more responsibility and control away from their clinicians. The focus should be on providing as much autonomy to the patient as possible rather than monitoring or controlling them. But while autonomy can be beneficial, the aim should not always be complete autonomy. Different treatment decisions have distinct autonomy levels and in some cases, the condition may be too complex and require the help of clinicians. The system should cater to a wide range of users as it is difficult to make assumptions as the chronic condition may affect the users differently and their skills may vary. Nunes et al. [18] also provide several points to discuss regarding how to visualise health data:

- Levels of understanding health data. When a patient is newly diagnosed an overview is more useful. As a patient becomes more knowledgeable, the individual contextualised value may become more useful.
- Amount of data to analyse. Visualised contextual values enable the patient to better understand but only if the patient is knowledgeable enough to know which value to investigate and its meaning.
- **Complementary visualisation strategies.** As designers, we tend to choose one strategy over another but it might be beneficial to combine both.
- Multiple visualisation perspectives for different types of users. If the system has different types of users, it should use several different interfaces to tailor to the specific interests of different users.

Digital health tools can produce inequality by disproportionately benefiting more advantaged people if not designed properly. Therefore, it is important to design with differing levels of literacy and health literacy in mind [26].

When designing for patients it is especially important to design with usability in mind as poorer health makes it more difficult to use a system. A study by Das et al. [9] had 14 patients with cancer and 14 healthy controls perform the same tasks. The cancer patients had a worse completion rate and they were more likely to give up on sub-tasks.

2.2 HCI in Doctor-Patient Communication

Färber et al. [11] found that most of the patients and physicians endorsed the idea of a digital medical assistant that could give a short summary of the consultation and physicians recommendations. A focus group study by Maguire [16] found that patients desire a system that gives them access to summaries and routine data about themselves. Summaries are also proven to help patients adhere to care recommendations [27].

Through a qualitative field study, Chen [8] found that patients with chronic conditions find and use health information in cycles, based on their routine doctor consultations every three to six months, which they refer to as Chronic Care Cycles. Although the consultations are short in length, the information given and gained is crucial for a patient. The start of the consultation has information presented by the patient about home care such as reporting discomfort and feelings from the previous consultation. The end of the consultation has the doctor giving clinical information regarding how to manage their condition which directs the next cycle of home care. Patients are usually knowledgeable about their disease as they have to manage it for the majority of the time outside the healthcare environment. Chen [8] suggests future chronic care management systems consider organising personal health information through the temporal cycles of the home and clinic rotations. Färber et al. [11] also suggested that doctor-patient communication was a loop consisting of three stages: Preparation, consultation, and follow-up. They suggested that one of the reasons that patients have trouble remembering details from the consultation is due to the limited time and the repetition of details. They introduced the 'My Doctor app' to serve as a helpful tool for both the patient and the physician with the intent to close the loop, removing both the preparation and follow-up phases to educate the patient and help them remember the information from the consultation.

Monteiro and Lopes [17] created a system to help patients store and understand the information given to them during a consultation. The system would transcribe the dialogue from consultations and give extra information regarding complex medical concepts. The system was tested using usability tests and the results were positive as the elderly participants could use it successfully with few interactions. Bickmore et al. [4] found that virtual agents have also been used in similar contexts for patients in hospitals. They created an interface with a virtual nurse (VN) that could educate patients with inadequate health literacy and be used from the hospital bed. The participants liked the amount of time the VN used to explain concepts to them as well as the amount of information it gave them. The VN was used to give information regarding a particular medication or diagnosis. Some of the participants even preferred the VN over the real nurses and doctors. The reason for the preference was that the VN was not time-restricted like the health professionals and that it would spend as much time as needed to ensure

they understood all the instructions. The increase in information also helped empower the patients to become more actively involved in their health.

2.3 Audio Recording of Consultations

Audio-recording a medical consultation with a healthcare professional has been a subject within the medical field since the late 1970s.

Three studies reviewed papers regarding giving the patient additional information after the consultation: one regarding audio recordings of the consultation to patients [25], one looking at the effectiveness of consultation recordings [21], and another specifically looking at audio recordings or written summaries for people with cancer [19]. Despite all three studies discovering the benefits of the application of recordings, it has yet to become common practice.

2.3.1 Usage of Recordings by Patients. All three studies [19, 21, 25] found that the majority of the participants did listen to their recordings. Tsulukidze et al. [25] reports a weighted average of 71,63%, and Rieger et al. [21] found that at least half or more of the participants in 20 studies listened to their recordings. The recordings were not only used to recall information from the consultation but also to share the information with others, mostly friends and family although some also shared them with their healthcare providers. The participants also heard the recordings multiple times but recipients of 'bad news' were less likely to hear the tapes multiple times [21, 25]. Even though some participants reported that listening to the tape was traumatic they were better at understanding the information than the group with no tape [25]. It was also identified that recordings with 'bad news', such as distressing content, could increase a patient's anxiety when replaying [21].

2.3.2 Impact on Information Recall and Understanding. Tsulukidze et al. [25] found that 22 out of the 26 studies, that did report an impact on understanding and recall of information, had a positive impact, while four studies did not find any significant effect. Pitkethly et al. [19] reported a positive effect in five out of nine studies. Rieger et al. [21] looked at nine randomized control trial studies that assessed the impact of recordings on knowledge, perception of being informed, or recall of information. Five of them saw significant positive results.

Two studies [12, 13] reported that patients who were provided with an audio recording could provide significantly more information regarding the side effects of the treatments. Additionally, one of the studies found that the participants could provide more information regarding treatment alternatives and felt provided with more information compared to the group without an audio recording. Tsulukidze et al. [25] found that in studies that used a control group, the group with audio recordings could recall significantly more information discussed during the consultation. The studies without a control group also corroborated similar results. The patients also felt that the audio recording helped them better understand their treatment alternatives and side effects. Additionally, the people most likely to benefit from the audio recordings of the consultation would be (1) those from an older population, (2) those who were overwhelmed during the consultation, (3) those of lower socio-economic status, and (4) those who are impaired.

2.3.3 Organizational Factors. The act of audio recording the consultation could be a problem as it could disrupt the workflow and lengthen the consultation time. Haslop [14] found that audio recording of medical consultations did not substantially add to the consultation time, while Belkora et al. [3] reported that it did occasionally cause delays. Tsulukidze et al. [25] reported that healthcare professionals' stances on audio-recording consultations were mixed. Albeit the benefits are known, some healthcare professionals were concerned with the intrusive nature of recording the consultations and felt that it might discourage free flow and open discussion. Rieger et al. [21] found that some healthcare workers felt more self-conscious and anxious due to being recorded and they were concerned that the consultation may become more formal or structured. Others, however, believed that it would not impede clinicians from sharing information and could potentially increase accountability, which could increase the respect for clinicians who were willing to be recorded.

3 Contextualisation Study

In this contextualisation study, we seek to examine the communication barriers in the Danish healthcare system patients with chronic conditions experienced prior to their contact with an MS [24]. To initiate the study, we interviewed a paediatrician and a dermatologist regarding how they convey diagnosis information to their patients. Both MSs expressed that improving a patient's health literacy, particularly with respect to the diagnosis received from their GP, could ease the difficulty in understanding the information from the MS, potentially mitigating communication barriers and achieving more effective communication with healthcare professionals. These interviews raised the following question:

"What are the communication barriers that limited health literacy creates that prevent effective communication between a patient and a medical specialist?"

Research has confirmed the insights from the two MSs we spoke with, highlighting the challenges and communication barriers that impede effective communication and comprehension between patients and healthcare professionals [1]. It was also revealed that doctors' use of medical terminology and complex language during interactions with patients can render the intended information beyond the average patient's comprehension [7]. Information seeking is common practice, particularly among patients who may have the desire to expand their understanding of their diagnosis and what kinds of treatment it may entail. The issue with information overload is not the quantity of information itself, but the difficulty in distinguishing relevant information from irrelevant information due to a lack of effective strategies [15].

3.1 Participants

Nine participants were recruited through the patient association, Patient in Focus, which is an international, non-profit disease-neutral organisation built by patients. To be eligible for participation, the participants must have been in contact with an MS at least once. The participants had a mean age of 48.7 years with an age variance of 13.1 years. Furthermore, the participants had a mean time spent with a diagnosis of 13.4 years with a variance of 8.9 years.

3.2 Method

We collected and coded 40 medical forum posts from 12 online medical forums. After the forum posts were coded, we conducted an inductive thematic analysis [6] to help us get insights into what patients might look for when looking for information regarding their chronic conditions. The findings from the medical forum posts were used as a foundation to create an interview guide for patients who have had consultations with an MS. We performed nine semi-structured interviews with eligible participants. Subsequently, we coded all the relevant statements from the interviews and performed another inductive thematic analysis. The groupings from the thematic analysis were ranked based on how frequently a pain point was mentioned and the relevancy to the research question.

3.3 Results

This contextualisation study provided an opportunity to promote improved communication between healthcare professionals, specifically MSs, and patients by establishing common ground. The emphasis on chronic conditions stemmed from our initial interviews with two MSs. Our focus on online forums pertaining to chronic conditions, as opposed to non-chronic conditions, was motivated by our belief that patients with chronic conditions require greater health literacy. As all evaluations were conducted in Danish, all quotes were translated into English.

The thematic analysis of the interviews helped us identify four themes: (1) Information seeking, (2) Treatment, (3) Consultation, and (4) Ways of communication.

3.3.1 Information Seeking. It was revealed that the participants turn to online forums and Facebook groups for information about their diagnosis. Five out of nine indicated Consultation Companion

that they primarily taught themselves and relied on online forums for information about their diagnosis and treatment.

"It was mostly through the Facebook group or my own experiences" - P7

P7 stated that they verified the information found on online forums and groups with their doctor.

"[...] later on when I ask my doctor, he usually confirms that [findings from the group]" - P7

3.3.2 Treatment. Participants who believed they had limited freedom of choice acknowledged that the process of finding the right treatment can be long and tiring due to variations in how the diagnosis presents in individuals.

"The attending doctor sort of guides you in the direction they feel is most optimal in the current situation [...] if that does not work then you try something else" - P1

3.3.3 Consultation. Five out of nine participants reported not being able to completely comprehend their diagnosis when initially received from an MS. P5 mentioned the difficulty of remembering all the information due to their physical and mental condition.

"[...] if you've just been diagnosed, it's hard to remember so many things" - P5

Five out of nine participants reported that their GPs were not adequately informed and referred them to an MS without providing sufficient information about their condition.

"No, because I knew nothing about it and what was wrong with me." [When asked if they prepared for the first consultation with an MS] - P2

3.3.4 Ways of Communication. Five participants mentioned that their MS used visual aids, such as pictures or drawings when explaining the diagnosis. P5 specifically noted that a previous doctor used drawings to clarify her diagnosis.

"I've actually had a doctor that drew a lot, and sometimes you have to see the things that they are talking about, drawn out to understand it." - P5

Furthermore, four of the participants reported receiving pamphlets after their consultation, and one participant was referred to a YouTube video. In contrast, three participants did not receive any visual aids in addition to the verbal explanation provided by their MSs. P8 noted that newly-diagnosed diabetics are still receiving the same information through pamphlets as he did more than a decade ago.

"They also receive pamphlets [about diabetes] but that means that they probably do not get more [information] than I did back then" - P8

3.4 Takeaways

We found that the information provided by the Danish healthcare system could be improved to better fit in with the wishes or needs of patients with chronic conditions. Our findings implicate this can be achieved by making health information more comprehensible, thereby, enhancing patients' knowledge about their condition and preparing them for consultations with healthcare professionals.

3.4.1 Communication Barriers. Our findings indicate that medical journals often employ complex medical terminology, making it difficult for individuals without prior medical experience to understand the content. However, the patient may not be the primary target audience for these medical journals but rather used as a medium for doctors to get an overview of a patient's medical history. Moreover, patients frequently struggle to recall critical information discussed during consultations due to the lack of specificity in their journals. Participants expressed a desire for a more comprehensive journal that would facilitate the retention of essential information, as overlooking such information could be detrimental. Our research highlights the importance of developing a system that can help patients prepare for consultations with their MSs to improve communication efficacy. To summarise, the communication barriers were:

- Patients are not prepared for consultations due to a lack of health literacy regarding their diagnosis.
- Information is not communicated in a manner that can be understood by patients.
- Health journals can often not be used to recall information from the consultation as it is too vague.

3.4.2 Next Step. These findings lead us to investigate ways to overcome these communication barriers. For the remainder of this study, we will focus on two of the identified communication barriers: "Patients are not prepared for consultation due to a lack of health literacy regarding their diagnosis" and "Information is not communicated in a manner that can be understood by patients." To capitalise on the opportunity to capture the information at the consultations for later use, we will look at ways to increase the patient's understanding of their medical condition through a mobile application. We chose not to pursue the communication barrier "Health journals can often not be used to recall information from the consultation as it is too vague" as it relies on how healthcare professionals submit their entries of a patient's health journal.

4 Consultation Companion

'Consultation Companion' is a mobile application that enables patients to better understand information regarding their diagnosis based on audio recordings with their doctor. The idea revolves around a system that transcribes and

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Figure 1. Overview of main screens. (1.a) Home, (1.b) Consultations, (1.c) Individual consultation, and (1.d) Transcription.

1.a).

summarises audio recordings of a medical consultation between a patient and a doctor. Medical terminology in the transcription and summary are highlighted and assigned to a pre-defined information box e.g. RA would display information extracted from a trustworthy site, such as sundhed.dk, about its causes and the different treatment options. We developed a hi-fi prototype of 'Consultation Companion' which will act as an artefact to spark a conversation during testing to investigate how to overcome the aforementioned communication barriers. The consultation used in the prototype is an excerpt of a real follow-up consultation with a nurse from the Department of Rheumatology at the Regional Hospital Hjørring. The information boxes and the transcription, in the prototype, were created by us.

4.1 System and User Interface

The prototype is a mockup with no written code. The development of the prototype was split into two parts; designing the screens in Figma, and implementing the functionality and interactions in Protopie. The prototype designs and user flow were planned on Miro.

The application revolves around four screens: (1) Home, (2) All Consultations, (3) Individual Consultations and (4) Transcription. We will describe the system through a usage scenario: Bob, a patient who has been using 'Consultation Companion' during his consultations with medical professionals. He is a newly diagnosed RA patient and was overwhelmed with information during his recent follow-up visit with the nurse regarding RA. keywords. After reviewing the summary and keywords, he was able to recollect most of the events of the consultation.

4.1.2 Consultations. All consultations are displayed with their own consultation card (see Figure 1.b). Each consultation card includes the consultation date, a title, the medical professional that treated them, relevant keywords, and whether the consultation has a transcription attached. The consultations are sorted by date, but can also be sorted by length of transcription, doctor involved, and in alphabetical order.

4.1.1 Home. Home allows the user to get an easy and

fast overview of the most recent consultation, and a way to

access all their consultations and prescriptions (see Figure

most recent consultation: a consultation with a nurse regard-

ing his newly-diagnosed RA. However, Bob can not recall the

consultation details, so he decides to read the summary and

Upon opening the application, Bob is presented with his

To facilitate easy access to consultations, we implemented a search box and a filter for users to search for specific consultations (see Figure 2). We have therefore chosen to present the keywords in descending order of frequency. For example, in consultations regarding RA, the terms such as 'pain', 'tenderness', and 'stiffness' might be mentioned more frequently than 'fatigue', or 'maintaining a healthy weight'.

Bob wants to look for certain consultations regarding his medical history with RA. Specifically, he wants to look for consultations with RA, where the keywords 'rheumatoid arthritis', 'tenderness' or 'swelling' appears. Bob taps the

Consultation Companion



Figure 2. Filtering consultations. When filtering, consultations which include at least one of the filters will appear on the list of consultations.

keywords on the top of the screen, and doing so presents the consultations that include the selected keywords.

4.1.3 Individual Consultation. Users can access detailed information regarding an individual consultation. The system presents a summary to give the users a quick overview of the transpired events during the consultation, a transcription for listening, suggested measures for their medical condition, and keywords that appeared during the consultation (see Figure 1.c). The summary is designed to give the user quick and interpretable information regarding the contents of the consultation, e.g. how they will proceed with treatment, why a specific medication is prescribed and how it is administered. Medical terminology and other important information such as treatment procedures are highlighted in bold and underlined - now referred to as keywords. If a keyword is tapped, the user is presented with information regarding that keyword in the form of an information box (see Figure 3). For example, if a user taps the keyword 'tenderness', the system will present information on what causes it and how to alleviate it. We have designed the keywords section to give the user a clear representation of keywords that appeared during the consultation. Similarly to the highlighted words, if a keyword is tapped, the user will be presented with information regarding the keyword.

Bob is interested in knowing more about the main takeaways of his consultation with the nurse regarding RA. Upon reading, he noticed that certain words were emphasized. Bob recalls that he did not fully understand what RA is and decides to tap on its corresponding keyword. Upon doing so, an information box provides a definition and explanation of RA. Bob capitalises on this opportunity to learn more about his diagnosis and what treatment options are available.

4.1.4 Transcription. Tapping the transcription section on the 'Individual Consultation' screen redirects the user to



Figure 3. Keyword interaction. When a keyword is tapped an information box opens up and presents more information.

a new screen that allows them to playback, listen, and read what was said during the consultation verbatim (see Figure 1.d). The transcription will highlight medical terminology such as treatment procedures and keywords to allow users to further inspect and research on their own. These words are highlighted with underline, bold and colour. The colours are separated into three categories: 'Symptoms & diagnosis', 'Medication & treatment', and 'Miscellaneous'. If a keyword is tapped, the user will be presented with information regarding the tapped keyword like what happens in the Individual Consultation.

The transcription is annotated with titles and timestamps based on conversational topics that transpired during the consultation. Topics and timestamps are added to the list of chapters found on the top right by tapping the 'chapters' icon (see Figure 5). This allows for easy navigation to different topics, as they are conveniently located in the same location.

Bob wants to hear exactly what was discussed regarding pain relief. To accomplish this, Bob navigates to the transcription screen by tapping the transcription section in the consultation and is presented with a transcription and an audio recording of the consultation. Since Bob cannot recall when the conversation about pain relief occurred, he taps the 'chapters' icon to view all the consultation's topics. Bob locates the chapter 'Pain relief discussion', and taps it, which forwards the transcription and audio-recording to its corresponding timestamp. Afterwards, he listens and reads the conversation about what the doctor had to say about pain relief.

4.1.5 Onboarding Tutorial. Both 'Individual Consultation' and 'Transcription' have their own onboarding tutorial that is presented the first time a user visits the corresponding screen. The onboarding tutorial is a pop-up presenting information about the screen's functionality and how they are utilised. The 'Individual Consultation' screen's onboarding tutorial has three pages: The first page explains in text that

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Figure 4. Onboarding tutorial for the 'Transcription' screen. First-time users will be met with an onboarding tutorial to help them learn about the system's functionality.



Figure 5. Transcription chapters. When the 'chapters' icon is tapped a list of conversational topics is displayed. Each list item skips the transcription and audio file to its corresponding timestamp.

certain words are highlighted and shows an example. The second page explains how information boxes will pop up after tapping a highlighted word, this is explained in text and shown in an animation. The third page explains the same interaction with keywords, with similar text and animation as before.

The 'Transcription' screen's onboarding tutorial consists of three pages (see Figure 4): The first page explains the highlighted keyword colours' meaning. The second page explains how they can be pressed and how an information box will pop up, shown with text and animation. The third page shows how to use chapters and where they are located with text and animation. The onboarding tutorials can be activated again by tapping the 'i' icon which is located top right on both screens.

5 Consultation Companion User Study

We present the details of our study in this section. The procedure consisted of giving the participants access to a hi-fi prototype of 'Consultation Companion' and asking them to study the chronic condition RA.

5.1 Participants

From March to May 2023, 13 voluntary participants (P1-13; 10 females, and 3 males, see Table 1) were recruited through a collaboration with the Department of Rheumatology of the Regional Hospital in Hjørring. All participants were newly diagnosed with RA. In this paper, we define 'newly diagnosed' as patients who have received their diagnosis within the past 12 months. The participants self-reported their health literacy, health literacy regarding RA, and technological competencies through a Likert-type response scale with seven categories ranging from 'very low' to 'very high'.

Before evaluating the prototype with the participants, we conducted two pilot tests to ensure the prototype's functionality was working. We also looked for any missing functionality that could give the participants a better experience when evaluating the prototype.

ID	Age	Gender	Occupation	Highest Level of Education	General Health Literacy	Health Literacy regarding RA	Technology Level
P1	70-79	М	Retired	High School	3	3	4
P2	70-79	F	Retired	Elementary School	4	4	3
P3	70-79	F	Retired	High School	6	4	2
P4	60-69	F	School teacher	Master's Degree	4	3	4
P5	40-49	F	Student	Bachelor's Degree	6	5	3
P6	30-39	F	Hotel Director	Other	4	5	5
P7	70-79	F	Retired	High School	2	2	5
P8	60-69	F	Retired	Bachelor's Degree	5	4	3
P9	60-69	М	Retired	Bachelor's Degree	4	3	4
P10	70-79	F	Retired	Master's Degree	4	4	4
P11	60-69	F	Designer	High School	6	5	5
P12	60-69	F	Retired	High School	3	3	4
P13	70-79	М	Smith	Elementary School	6	1	3
					Mean: 4.38	Mean: 3.54	Mean: 3.77

Table 1. Summary of the demographic of our study participants. During the test, the participants were asked how they would rate their general health literacy, health literacy regarding RA, and technology competencies on a Likert scale of (1) 'very low' to 7 'very high'.

5.2 Study Setup and Procedure

The study consisted of three parts: (1) a demographic survey, (2) a task-driven exploration of the prototype, and (3) a debriefing interview. The study took approximately 30 minutes, and the sessions were audio-recorded for further analysis.

5.2.1 Demographic Survey. During the first part of the study, the participants completed a brief demographic survey to provide general background information about themselves, their self-reported health literacy level, health literacy regarding RA, and technological competencies.

5.2.2 Task-driven Exploration. During the second part of the study, the participants were granted access to the prototype for them to explore and use as a medium to find information about the chronic condition. During the test, the participants were given tasks to navigate and explore the prototype. The tasks were purposely open-ended and vague to give the participants the freedom to complete them without instructions. They were given to the participants to ensure that each participant had to complete the same objectives in the prototype to make the data collected comparable and to guide the participants to the features of 'Consultation Companion'. These tasks can be found in Appendix A. During the exploration of the prototype, the participants were encouraged to articulate their thoughts out loud, and a facilitator was present to prompt them to do so.

5.2.3 Debriefing. Following the study session, a semistructured debriefing interview was conducted to collect information about their general thoughts regarding the application and its functionality. The questions regarding feedback from the system revolved around how they used the different features and if they were useful, how information was presented to them, how they would use the system in their daily lives and about possible barriers for adoption. The debriefing interview guide can be found in Appendix B.

5.3 Data Analysis

To investigate how participants utilised the prototype to better understand medical information during consultations, we conducted a qualitative analysis. This qualitative analysis involved examining audio recordings and the notes taken during the evaluation. To ensure a systematic approach, we carefully listened to each participant's audio recording to identify the types of personal insights in utilising the prototype to help them better understand medical information.

To guide our thematic analysis, we followed an outline by Brulé [6]. We coded the identified data extracted from the participants' personal insights and grouped them into various categories based on their similarities in content. We then assigned the groupings with descriptive titles. For example, the following quote was extracted from P3 during the task-driven exploration part of the study and was later categorised into the 'Presented information' theme:

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"It's surprisingly clear. You can tap [on a key-
word] and read about it." - P3
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After reviewing, sorting, and categorising the codes into themes, we thoroughly reviewed the data to identify any similarities among the themes that could be merged or grouped together under a shared theme.

Next, we thoroughly examined the relevance of each theme to our research question: "How can a medical health records application help patients understand the information given to them during a consultation?" During this process, we identified themes that were deemed irrelevant and thus removed from further analysis.

6 Results

In this section, we present the results found through our thematic analysis. Specifically, we examine the participants' feedback on the system, how they would use the system, how they understood the system, and their perceived barriers relating to data protection. As all evaluations were conducted in Danish, all quotes are therefore translated into English.

6.1 Demographic Survey Results

To provide background information on our participants, we present the results from the demographic survey regarding their self-perceived levels of knowledge regarding general health literacy, health literacy regarding RA, and the competencies with technology (phones, tablets, computers etc.) in comparison to the average person with RA (see Table 1.

Overall, our participants reported a normal to above average level of knowledge regarding general health literacy, and below average to normal level of knowledge regarding health literacy regarding RA, specifically. Regarding their technological competencies, the participants, on average, reported their level to be slightly less than normal than the average.

6.2 System Feedback

The majority of the feedback gathered from the participants was direct feedback on the system. The feedback could be categorised into two categories: How information was presented as well as their preference between mobile applications and physical material.

6.2.1 Presented Information. While the participants expected a lot of information on the 'Individual Consultation' and 'Transcription' screens, it was still overwhelming for five of our participants. P10 expressed that the system displays a lot of words and it might seem intimidating.

"There are a lot of words, but it's readable [...] If it had to be presented a little more clearly, you could imagine that there were fewer words on the page." - P10

However, five other participants mentioned positive remarks about how the information was presented and the relevance of it.

"There were a lot of highlights that might disturb the reading... Maybe it interferes with the reading a little with so many highlights." - P4

However, 10 of 13 participants were surprised by how information regarding specific keywords was hidden in information boxes.

"It's surprisingly clear. You can tap [on a keyword] and read about it." - P3

10 participants expressed their preferences for highlighted keywords, and how it helped them identify keywords as they found them to be easy to identify in the text, and enabled them to learn more about a specific keyword. One of these participants also remarked that the amount of information in the information boxes was appropriate. Another participant appreciated it when the information boxes contained illustrations. **6.2.2 Mobile Application vs. Physical Material.** As of now, the Department of Rheumatology in Regional Hospital Hjørring currently distributes physical pamphlets with information regarding RA. Due to this the participants often had comments about the difference between having it physically and on a mobile application. Three participants also reported issues with physical pamphlets. The participants knew that the pamphlets contained important and relevant information, but had complications storing and retrieving the pamphlets. These problems with physical pamphlets also manifested into issues regarding treatment.

you can see what it is about. That is what you

have to think about" - P12

"I just found out that I have not taken all the blood tests that I should have." - P6

Four participants mentioned liking the idea of having medical information stored on a mobile application, as it would always be available for them.

"I think it is wonderful to get it on the phone because then you always have it on you [...]" - P13

Two participants expressed the desire to have a digital solution that could be a catalogue for medical information.

6.3 Understanding the System

Presented information aside, the participants also had feedback regarding the functionality of the system and the onboarding tutorials.

6.3.1 Understanding System Functionality. Five participants had remarks about how quickly they understood the system. These comments were pertaining to the functionality of the keywords and the overview in 'Individual Consultation'. One participant, however, expressed confusion as to how the data was generated and that the additional information boxes connected to the keywords felt disconnected from the consultation.

"[...] There are these keywords where you can go in and read more about some of the things, but they do not seem connected to the consultation, some of them do." - P4

Four participants had no issues getting an overview of what the contents of the consultation were about and the purpose of the consultation.

6.3.2 Onboarding Tutorial. The onboarding tutorial on both screens was met with a lot of confusion and frustration from all participants as it was not clear to them what the tutorial was trying to accomplish and were disrupting them while doing their task.

"I see some instructions and I do not know why it says that, because I was supposed to see my consultation." - P4

11 participants had trouble understanding the contents of the tutorials. Animations were especially confusing to the participants as they were always misunderstood the first time they were encountered. The text explaining the animations was often overlooked by the participants. This resulted in them trying to interact with the animated example instead of properly reading the associated instructions. Four participants were observed to rush through the tutorial, tapping 'Next' without understanding or reading the pages fully and thereby skipping the tutorial.

"When I see something like this, then I am just in a hurry to move on." - P3

One participant did not experience problems with the second tutorial on the 'Transcription' screen as the participant fully read the tutorial, from beginning to end. Two other participants did recover after their initial confusion by carefully reading the tutorial until they understood it.

6.4 System Usage

The study was not only focused on getting feedback for the prototype but also to get insights into how they would use the system and if there were any barriers for adoption.

6.4.1 Recording Consultations. The participants' willingness to record the consultation was mixed. Four of the participants expressed that they would have difficulties asking their doctor if they could record the consultation. This was mainly due to them being unsure if the doctor would agree to it or because they thought that recording the consultation could disrupt open discussion.

"It's a bit transgressive [...] You should know the doctor well." - P13

However, four other participants would have no issues asking if they could record the consultation. Additionally, three participants expressed the opinion that the utilisation of the system should be a collaborative effort between the doctor and patient. They suggested that medical professionals should introduce the system to new patients and provide reminders to use it during consultations.

6.4.2 Share health information to their nearest. The people who are close to a patient are also interested in helping and being informed of the diagnosis. Eight participants expressed a desire to share the contents of a consultation with family members or close friends.

"She [their daughter] would also be interested in this [their consultation]" - P13

They explained the desire of having the contents of the consultation stored. As they mentioned it would give them the ability to precisely share the information received and do it more easily. Additionally, four of the participants went to consultations with a companion while the other participants were unaccompanied. The participants who were accompanied to their consultation commented that their companion was present to help them remember the information given during the consultation.

6.4.3 Preference for Recalling Consultation. The system could help with recall through two different channels, audio and written. The participants expressed mixed preferences as to which format they would prefer to recall the consultation with. Five participants preferred the audio recording, six participants preferred reading the transcription, and the remaining two participants enjoyed being able to do both. Two participants expressed their preferences for making use of the summary on the 'Consultation' screen to recall information rather than looking through the whole transcription.

"I don't think I want to sit and read through a whole consultation" - P4

Furthermore, two participants mentioned their usage of the prototype to refresh their memory of the contents of the consultation.

"Actually, I think that as documentation it is excellent for when you couldn't remember what it was you should. [...] If I was in doubt, I would go in and see what it was she [medical professional] said. That's what I would use it for." - P4

6.4.4 Participant Adoption. As there is no current alternative to another system with the same functionality as 'Consultation Companion', the participants were asked if they would use the system and their opinion on the premise. 10 participants expressed approval of the idea as they thought it could make their understanding of their diagnosis easier and more comprehensive.

"Especially when you are going alone, one's mind can be disturbed" - P4

Nine of the participants expressed that they would use a similar system if it was available. Two of the nine participants expressed a desire to use the system during consultations with their general practitioner. Three of the participants would not use the system as they deemed themselves too old to use it, but they still liked the premise of the system and one of them remarked that they would only use the system if it was on a computer. The last participant would not use it due to their consultations being less than five minutes and therefore they had no issues with recalling nor understanding the consultation.

6.5 Current Practices

The participants, when asked about how they would use 'Consultation Companion', often had remarks about their current practices and behaviour. The participants commented on the difficulties of remembering some details during consultations. Seven of the participants mentioned having such difficulties, noting that the challenges were particularly noticeable when they needed to explain information about their condition to others.

"Sometimes you come home and you're missing the answers to a few things" - P9

Two participants mentioned they often had emerging questions after the consultation and saved them for the next consultation. It was remarked by another participant who often prepared questions that not all questions they had prepared were answered during the consultation.

[When asked if questions emerged after a consultation] "Yeah, that can happen sometimes but [...] else I will write it down for next time" - P8

Furthermore, five participants expressed that if they have any emerging questions or forget something in regard to their condition, they would call the ambulatory.

Six participants indicated that if they have any doubts regarding the medical information they received during the consultation, they seek answers online. However, four participants expressed their concerns and caution about seeking information online, fearing they might become overwhelmed with information or come across potential symptoms that may not be relevant to their situation. In relation to seeking information online, four participants mentioned they frequently read about RA as they struggle to remember what was discussed during the consultation.

"I checked my file many times for information regarding my medication." - P6

6.6 Data Protection

When asked, most participants had no issues with sending their audio files from the consultation into the system and a cloud service for processing. However, two participants mentioned concerns regarding feeling like they were always under surveillance due to the government and apps storing their information.

"You can hardly move in the kingdom of Denmark without being controlled [...]" - P9

These participants were still willing to share their data. Three other participants acknowledged concerns with data security as the information stored would be sensitive personal information. Two of these participants also stressed that the system had to conform to the GDPR and take additional security measures.

"There must be some data security because it is sensitive personal information about me" - P4

One participant thought that the system might not be feasible due to legal issues with transcribing a conversation from a consultation. "There are actually some legal things with this, so it is a no-go." - P5

To help with data security, the participants thought that the system would need some kind of personal authentication to access their personal medical information. They suggested integrating NemID or MitID into the system as a method of increasing security as they are commonly used for similar applications in Denmark.

7 Discussion

Through the presented study, we aim to understand how a medical records application can help patients better understand the information given to them during a consultation. This creates an opportunity to develop a platform for patients to gain a better understanding of their diagnosis and what it might entail. Following prior work on designing for mobile applications in healthcare [18], HCI in doctor-patient communication [4, 8, 11, 16, 17, 27], and audio recording of consultations [3, 12-14, 19, 21, 25], we present findings on how to help Danish RA patients with understanding the information given during consultations. We conducted a contextualisation study to understand nine chronically ill patients' experiences with the Danish healthcare system and identify communication barriers between patients and doctors. We used these communication barriers as a foundation to develop the prototype, 'Consultation Companion'. During evaluations, the prototype acted as an artefact to spark a conversation with 13 participants during evaluations. These conversations were analysed using inductive thematic analysis.

7.1 Visual Representation

The contextualization study showed that one of the issues that patients can have is information overload, specifically in the early stages of a diagnosis, and the overload is due to a lack of ability to filter information efficiently [15, 24].

Additional features for filtering information, such as a search function, could mitigate this.

The information presented by the system was overwhelming for some of our participants due to the amount present on the screen at once. However, for other participants, the amount of information presented was appropriate. Nunes et al. [18] suggested that if a system has different types of users it should support different interfaces to tailor to the needs of different users.

Even though the information boxes also contained a large amount of information, the participants had surprisingly positive remarks regarding its contents, rather than it being overwhelming. We hypothesise that the positive remarks are due to the 'heavy' information being hidden behind its respective keyword.

The participants preferred colour-coded keywords but there were issues regarding remembering what each colour

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symbolised. However, the colour-coded keywords could also be disruptive as they were prominent. This could be an issue if there are many keywords clustered closely, like on the 'Individual Consultation' screen (figure 1.c).

7.2 System Usage

Tsulukidze et al. [25] reported that the reception of doctors for recording the consultation was mixed and that the intrusive nature may disrupt the free flow and open discussion. Rieger et al. [21] also reported that some healthcare workers would feel anxious if recorded and they were concerned that consultation may become more formal or structured. Similarly, our participant's willingness to record the consultation was also mixed, but the main barrier for the participants was the perceived reception of their doctors. If recording consultations was standard practice or was done in collaboration with the doctor, it is likely that the participants' willingness to audio record would increase. Even though it is recommended to patients in Denmark to record medical conversations, none of our participants has ever recorded a consultation. Notably, the British Medical Association (BMA) [2] currently recommends audio recording medical consultations, and the Danish healthcare system generally recommends bringing a companion or recording the consultation in order to make sense of its content [20].

The motivation for the user to use a system to help them recall and understand a consultation is not only for them but also for their friends and family. The ability to send the contents of the consultation to friends and family would allow them to share health information easily without arranging a phone call or a physical meeting. These results corroborate the findings from the three studies by Tzulukidze et al. [25], Pitkethly et al. [19], and Rieger et al. [21]. These three studies found that the participants did not only use the audio recordings of the consultations to recall information but also used to share with friends and family. Sharing medical information with friends and family was also apparent with some of our participants. If the system could fulfil the role of assisting patients in remembering the contents of the consultation, their companions would not need to take a day off work to provide their support. This would alleviate the need for the participants' companions to be present if their only purpose is to help them remember medical information.

Each participant had a preference for recalling the consultation, either by listening to the audio recording or reading the transcription. Therefore, it would be essential for the system to accommodate both preferences. This would ensure that patients have flexibility in accessing and revisiting the medical information in their preferred format.

During the evaluations, the participants would utilise the system to learn about their diagnosis and recall the information from their consultation. Primarily, they would use the summary to gain an overview since it is faster and easier. The participants also mentioned that the system would be most useful during the early stages of being diagnosed as they were most uncertain during it.

Färber et al. [11] and Chen [8] both suggest that chronic care management by patients happens in loops or care cycles, but this was not examined in this study. The participants also commented on having questions before and after the consultations as well as the need for having them written down to help remember them.

Currently, if the participants have any questions or forgot something regarding their diagnosis, they would call the ambulatory. If the system was able to help them with their questions or help them recall the information, it could ease the workload on the Danish healthcare system.

As seen in the results, most of the participants had no issues with uploading their consultation into a cloud service. However, three of the participants mentioned their concerns with how the data would be handled and how GDPR affects it, as well as how the current state of the system would have to implement a layer of security by authenticating through NemID or MitID for them to be comfortable using it.

The studies done by Tzulukidze et al. [25], Pitkethly et al. [19], and Rieger et al. [21] all report that the majority of the participants would listen to their recordings and our results are similar when combining participants who would read the transcription or listen to the recording.

Our study did not measure the impact on information recall and understanding but the three aforementioned studies did, and they report a positive effect in most of the studies. As the consultation would be stored on their phone using 'Consultation Companion', the user would be able to access information regarding the consultation when needed which could impact their ability to recall information. However, the participants remarked they would mainly use the system to get a better understanding of their diagnosis and also to help recall the information.

7.3 Communication Barriers

The prototype was designed to overcome two of the three communication barriers that were identified in the contextual study. The two barriers were:

- Information is not communicated in a manner that can be understood by patients.
- Patients are not prepared for consultation due to a lack of health literacy regarding their diagnosis.

To communicate information in a manner that the patients could understand, the system provides summaries of consultations, highlights keywords to which it provides an option for additional information, and provides a full transcript of the recorded consultation. The results show that the participants understood what the provided consultation was about as they were able to explain it. Furthermore, the information boxes in the 'Individual Consultation' and 'Transcription' screens were received positively, as it allowed them to read further details about related medical terms pertaining to their diagnosis. The participants capitalised on the opportunity to recall and understand more about their diagnosis. Our results corroborate the results from the study by Färber et al. [11] and the study by Maguire [16] as the general consensus among our participants were positive regarding the system and the majority reported that they would use the system if it was available. However, when looking at specific parts of the system, the results show both positive and negative remarks on different features in the system. Some of these features hindered and obstructed the participants multiple times, and the facilitator had to intervene.

7.4 Implications

We identified several implications to help elderly patients understand the information given to them during a consultation through a medical health records application and overcome the two communication barriers.

A medical health records application, such as 'Consultation Companion' could aid patients in recalling and understanding information from consultation and act as a digital companion, which could reduce the reliance on external companions.

Furthermore, the results show the importance of audio playback and transcription capabilities. Allowing patients to listen to the consultation again at their convenience and providing a written transcript, enables them to better understand and recall their consultation.

Additionally, we determined that while it is essential to provide comprehensive information, the system should initially limit the amount of information displayed. This approach could prevent information overloading the patient but still enable access to more in-depth information. In addition, the participants also wanted to have the information from the current physical pamphlets on a mobile application.

Lastly, a significant implication was the ability to share the contents of a consultation. Enabling patients to share this information with their families or friends could facilitate better communication to ensure that everyone involved is informed. Furthermore, it enables friends and family to get an understanding of the consultation's content without being present.

7.5 Limitations

For this study, we recognise several limitations with the study participants, designing the prototype, and the visual representation of health information.

7.5.1 Study Participation. Even though the chosen online forum posts were from worldwide forums, our participant pool for the contextualisation study was limited to patients in the Danish healthcare system, as they were recruited by an external partner who focused on the Danish healthcare system. However, due to the limitation of Danish patients

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in the Danish healthcare system, it is uncertain whether our findings apply to other countries. The participants for the contextualisation study were required to have a medical diagnosis given to them by an MS. This resulted in only interviewing patients with chronic conditions through our partnership with an external collaborator. However, since our participant sample only consisted of individuals with chronic conditions, our results may be biased towards that group despite meeting the participation requirement. Our findings suggest that patients with chronic conditions require greater health literacy, but it is uncertain whether the same need exists for patients with non-chronic conditions. Additionally, our participants had on average been diagnosed for 13.1 years before participating in the study, which required them to recall experiences from over a decade ago. Recalling events from over 13.1 years ago does not necessarily reflect the current Danish healthcare system.

For the Consultation Companion study, we recruited 13 newly diagnosed patients with RA. This allowed us to obtain information that reflects the current Danish healthcare system. However, while RA can affect everyone, it is much more common among the elderly aged 60 years and above, which has been reflected in our list of participants.

Another approach could have been to work with a medical condition that is more evenly spread among all age cohorts or work with various medical conditions. This would have enabled us to obtain information on the healthcare system's current state that reflects the needs of all age groups, rather than solely focusing on the elderly population, as in the case of RA.

7.5.2 Designing the Prototype. As the intended product is meant to target all patients in the Danish healthcare system, we went for a universal design to include as many users as possible. In retrospect, as the prototype only acted as an artefact to spark conversation during the experiment, we should have designed it specifically for elderly patients with RA, as that was the target audience for this study. After our pilot tests, we quickly found out that we needed to make the font size larger and explain the different features of the prototype to the users. This led to the development of onboarding tutorials, to give the participants a better understanding of the system and how it works. Even after the corrections, these problems can still be found in the results, as most of the participants still wanted the font size to be larger - or at least have the option to zoom in on the text.

Furthermore, we encountered problems with the onboarding tutorials, as we observed the participants found it confusing. In retrospect, we could have utilised contextual clues, using indicators like coach marks, tooltips and such to be less disruptive and teach the user along the way rather than all at once and have them recall the steps. The transcription used in the system is only an excerpt from a real consultation as the transcription is only 13 minutes from a one-hour-long consultation. Only using this small part, the content of the 'Transcription' screen was still overwhelming for users, as they had trouble finding specific information in it. Presenting the medical information given during a consultation can be challenging as it is very comprehensive.

7.6 Future Work

One of the main barriers to a system similar to this is the currently available technology for transcribing audio recordings. As the content of the system is based on the transcription, an error in the transcribing process could lead to misinformation. Information about health is critical and misinformation can have severe consequences. Further research should look at a way to make the patient confirm critical information, such as treatment, from the transcriptions or display how accurately the system thinks each sentence was transcribed.

We did not examine if the system had a positive impact on users' ability to recall and understand information from their medical consultations, therefore, a study to measure this could be needed. A longitudinal study field study with participants that had to use the system for their first consultation could yield insights into how the system would be used in its intended context. The study could measure the health literacy of a control group and compare it to the group using the system to see if there was a statistically significant difference.

We designed 'Consultation Companion' using universal design rules but did not focus on accessibility features such as text-to-speech to help low-vision or blind users. Our participants all had a RA diagnosis which can physically impair them therefore, integrating some form of non-physical form of interaction, such as speech recognition, could help them use the system.

8 Conclusion

To answer the research question: "How can a medical health records application help patients understand the information given to them during a consultation?" We developed a prototype of 'Consultation Companion' based on the three communication barriers derived from our contextualisation study. Of these three communication barriers, we chose to combat the following two: (1) Information is not communicated in a manner that can be understood by patients, and (2) patients are not prepared for consultation due to a lack of health literacy regarding their diagnosis. We conducted evaluations with 13 RA patients to gain insights into their experiences with understanding medical information regarding a consultation through the developed prototype.

We learned how to enable elderly patients, with RA, to get a better understanding of the information gained from a

consultation through a medical health records application. The implications of the study are that systems such as 'Consultation Companion' could aid patients with recalling and understanding information from their consultations, should support both audio playback and transcriptions, limit the amount of information displayed but also give access to indepth information and lastly enable patients to share the information with friends and family.

Additionally, we have highlighted areas and barriers for further research. One barrier to a system like 'Consultation Companion' is the current technology for transcribing audio recordings, which can lead to misinterpretations and misinformation. We suggest that further research should focus on confirming critical medical information, and measure the system's impact on patients' understanding. Furthermore, evaluating health literacy and enhancing features for accessibility, such as text-to-speech, and speech recognition, would improve the system's accessibility for individuals with physical impairments, such as RA or low vision and blindness.

This paper suggests strategies to overcome the aforementioned communication barriers, specifically through the development of a mobile application. By enabling patients to better understand their chronic conditions, they facilitate an active role in medical discussions regarding their chronic conditions and treatment options. This gives the patients the opportunity to establish more effective healthcare interactions with medical professionals.

Acknowledgements

We want to thank Mona Kyndi Pedersen and Asta Linauskas for their valuable insights, guidance, and recruitment opportunities. We would also express our gratitude to the whole personnel from the Department of Rheumatology at the Regional Hospital Hjørring for their hospitality and for allowing us to use their facilities to test our prototype. We would also express our gratitude to the participants who provided us with their insights and needs to help us help them develop a digital element to obtain better, reliable knowledge regarding their conditions and what it may entail.

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